LEC 04

CSE 123

Linked Nodes

Questions during Class?

Raise hand or send here

sli.do #cse123

BEFORE WE START

Talk to your neighbors:

What's your favorite data structure to use?

Instructor: James Wilcox

Reference Semantics

- In Java, variables are treated two different ways:

Value Semantics	Reference Semantics
Primitive types (`int, double, boolean`) + `Strings`	Object types (`int[], Scanner, ArrayList`)
Values stored locally	Values stored in memory, reference stored locally
Initialization copies value (many copies of value)	Initialization copies reference (only one value)

```
int x = 10;
int y = x;

y++;     // x remains unchanged
```

```
int[] x = new int[5];
int[] y = x;

y[0]++;    // x[0] changed
```

- We often draw "**reference diagrams**" to keep track of everything

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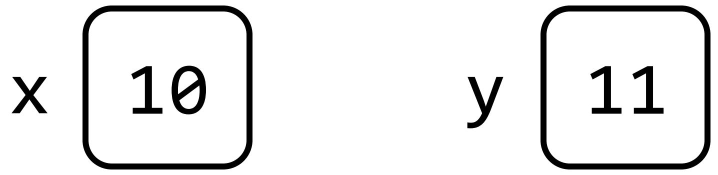

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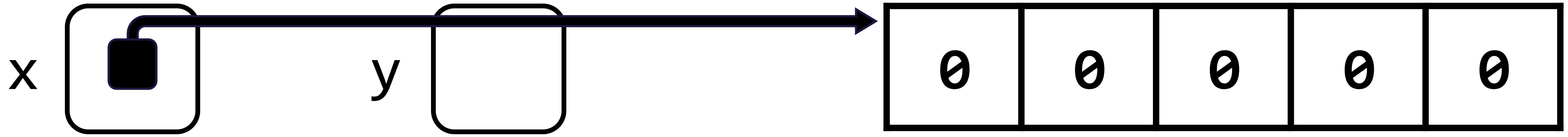

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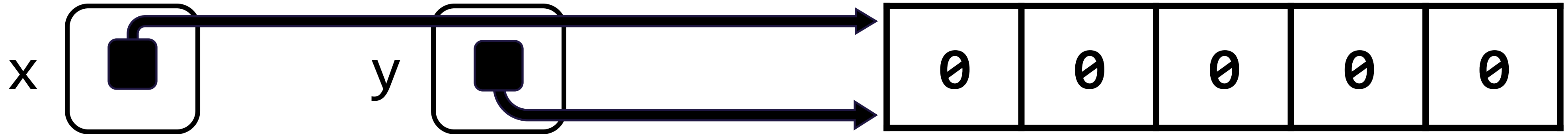

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`y++;     // x remains unchanged`
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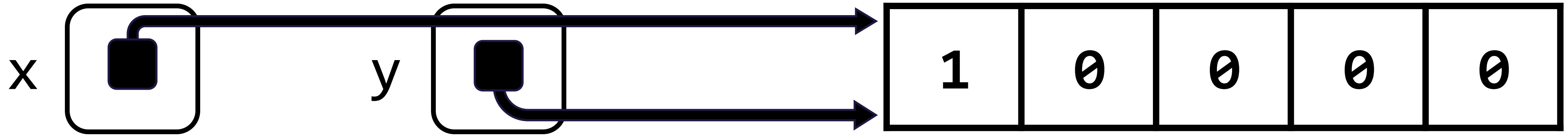

More trains!

Contiguous vs. Non-contiguous

- Computer memory = one really, *really* big array.

Memory

85	47	-51	44	-38	35	-58	79	27	-14	-9	-36	11	5
-24	-38	-66	-27	36	-1	23	20	31	-40	-97	-59	-4	62
-34	38	37	-52	-15	99	6	68	-67	-58	-85	-15	62	-29
13	-17	-85	-99	-20	-33	54	38	-66	8	9	53	71	39
36	24	27	90	-32	72	-73	11	-85	29	40	80	-77	-79
-90	-64	29	-27	91	64	28	-97	44	59	26	-35	34	21
-68	76	-1	-6	-52	77	21	37	80	69	-34	8	-79	-77
1	-46	-26	99	-24	-98	25	-79	92	-18	14	57	22	20
-76	-5	-86	-64	66	-78	47	-66	69	18	-74	-53	41	-86
-31	-9	90	-53	46	55	85	37	52	58	70	-13	59	79
17	20	91	-55	-74	0	-96	-69	-36	90	45	-60	-95	21

Contiguous vs. Non-contiguous

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  - `int[] arr = new int[10];`

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arr

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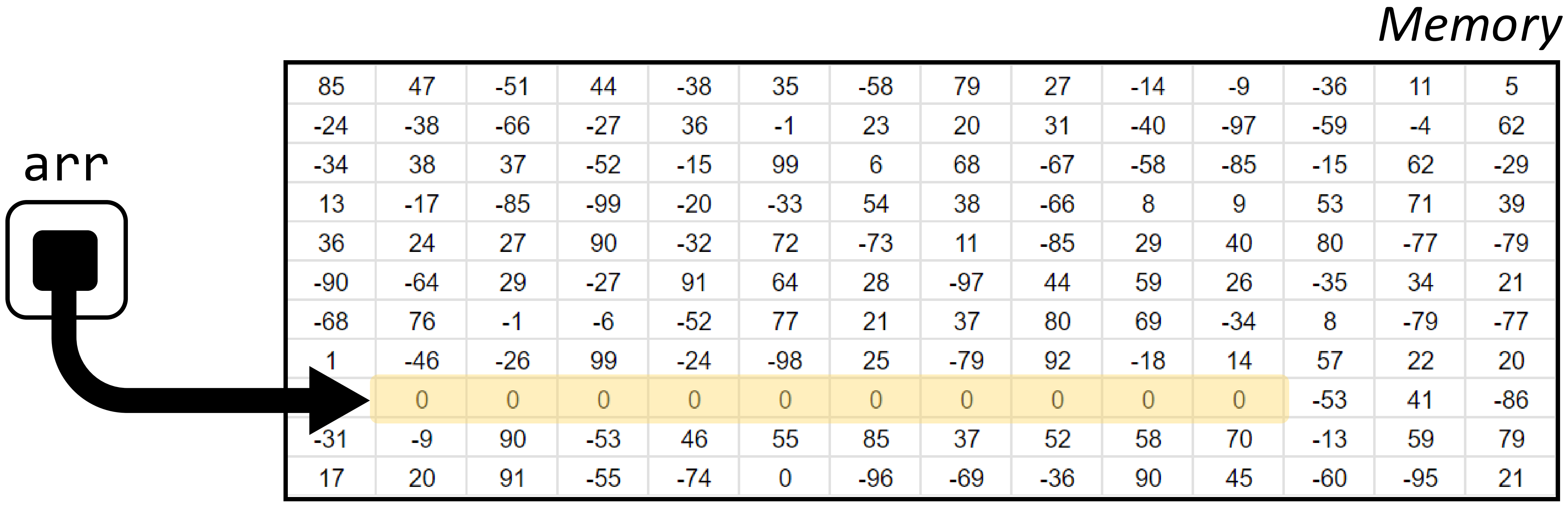

85	47	-51	44	-38	35	-58	79	27	-14	-9	-36	11	5
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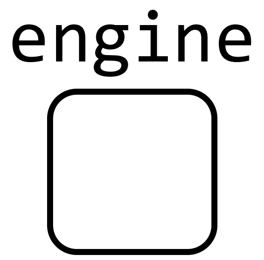
  - `EngineCar engine = new EngineCar(“Empire Builder”, 10,`
    `new SleeperCar(10));`



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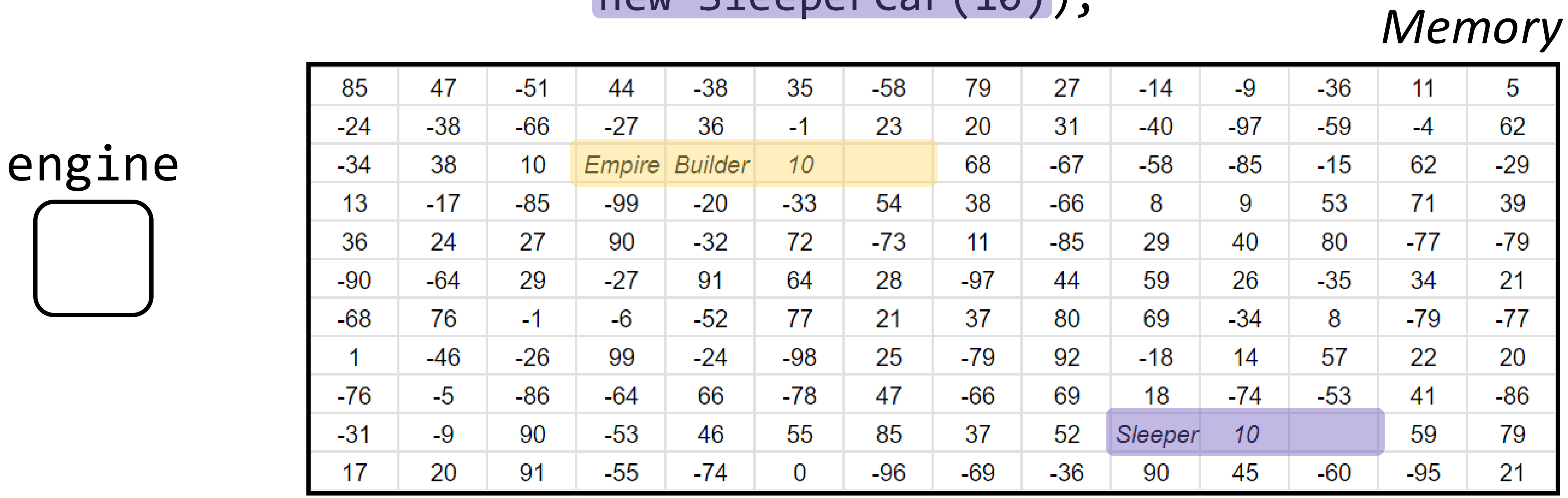

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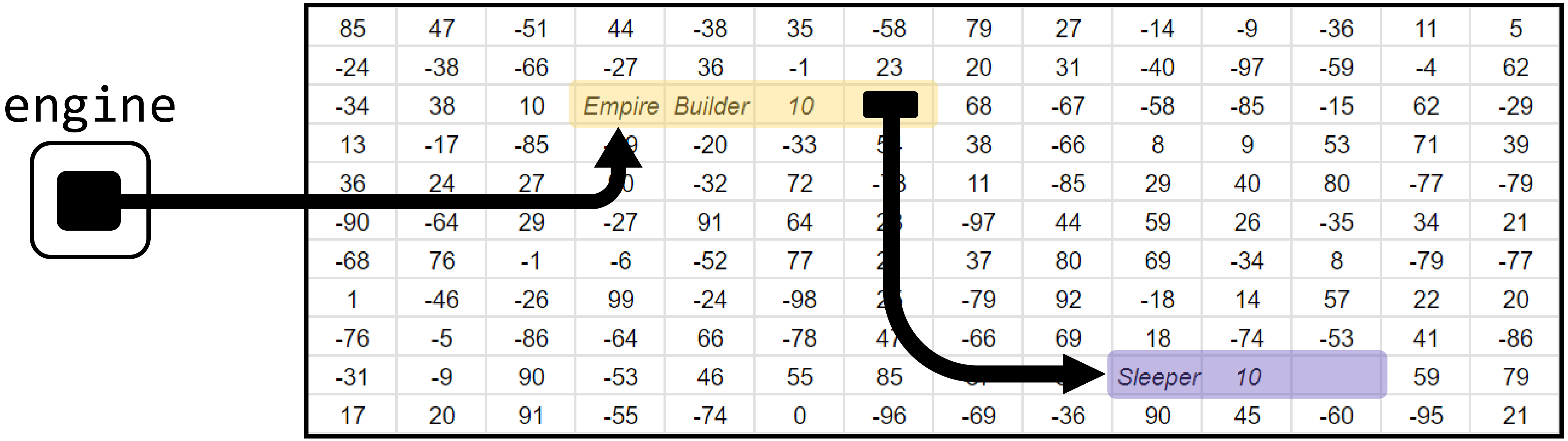

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Contiguous vs. Non-contiguous

- Computer memory = one really, *really* big array.

- Contiguous memory = impossible to resize directly
  - Surrounding stuff in memory (we can't just overwrite)
  - Best we can manage is get more space and copy
- Non-contiguous memory = easy to resize
  - Just get some more memory and link it to the rest

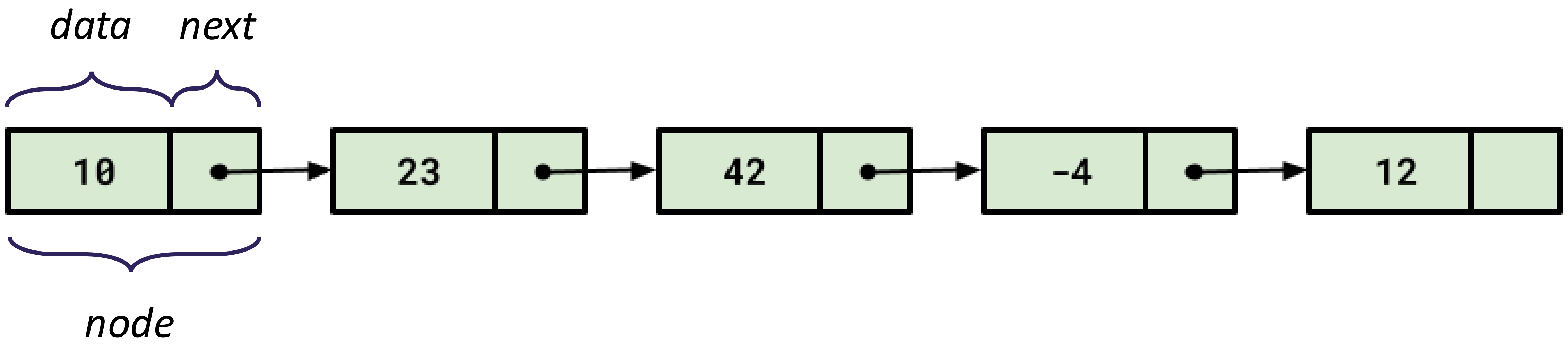
- Is it possible to create a non-contiguous List implementation?
  - Could make the resizing / shifting problems easier…

Linked Nodes

Linked Nodes

- We want to chain together `ints` "**non-contiguously**"
  - A bunch of train cars where each is responsible for a single integer

- Accomplish this with nodes we link together
  - Each node stores an `int` (*data*) and an reference to the next node (*next*)



ListNode

- Java class representing a "**node**"
- Two fields to store discussed state:
  - Fields are public?! We'll come back to this

- Why can `ListNode` be a field in the `ListNode` class?

```
public class ListNode {
    public int data;
    public ListNode next;
}
```

Iterating over `ListNodes`

- General pattern iteration code will follow:

```
ListNode curr = front;
while (curr != null) {
    // Do something

    curr = curr.next;
}
```